D-33-12-5-18
CT-01-RI-D(2)-II

REMEDIAL INVESTIGATION

VOLUME II
PUMPING TEST

CALDWELL TRUCKING COMPANY SITE
TOWNSHIP OF FAIRFIELD, NEW JERSEY

EPA WORK ASSIGNMENT
NUMBER 69-2LB3
CONTRACT NUMBER 68-01-6699

NUS PROJECT NUMBER S796

JUNE 1986

NUS CORPORATION

Park West Two
Cliff Mine Road
Pittsburgh, PA 15275
412-788-1080

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SUBMITTED FOR NUS BY:

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REGIONAL MANAGER
REGION II

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PUMPING TEST DATA INTERPRETATION

This volume presents and discusses the long-duration pumping test conducted for the Remedial Investigation (RI) at the Caldwell Trucking Company Site. Conclusions reached from pumping test information concerning groundwater flow direction under nonpumping and pumping conditions, including groundwater contour maps, are presented in Volume I of this RI report.

1.0 Introduction

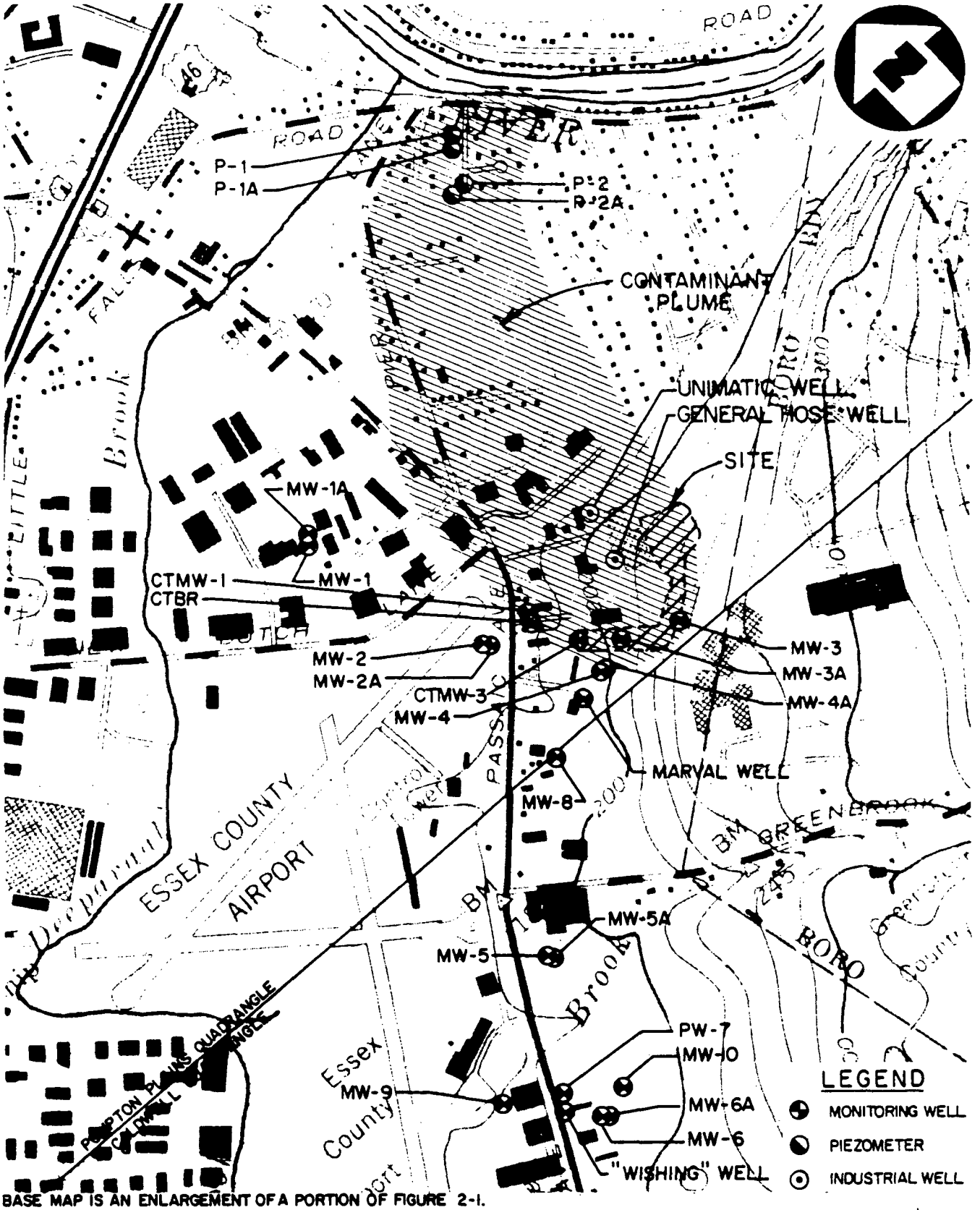
The pumping test was conducted after the completion and initial sampling of all newly installed and existing monitoring wells. The objective of the test was to determine the potential for long-term pumping of Municipal Well No. 7, located near the site, to reverse the groundwater hydraulic gradient from the site to this well.

2.0 Pumping Test Design

The pumping test was conducted using Fairfield Township Well No. 7. This well is located approximately 3,300 feet southwest of the Caldwell Trucking Company Site. On Figure 1, the Fairfield Municipal Well No. 7 is labeled as PW-7.

Fairfield Well No. 7 is an existing 8-inch-diameter water supply well. It is fitted with a 50-horsepower vertical turbine pump.

Pumping was initiated at 3:00 PM August 18, 1985, and was terminated at 3:00 PM August 25, 1985. Pumping was at a constant rate of 390 gallons per minute for 7 days. Discharge was measured using a 4-inch by 6-inch orifice weir with a gate value to regulate flow. Discharge was diverted into a sanitary sewer for the duration of the test. Drawdown and recovery in the pumping well was measured using a chalked steel tape inserted into an existing airline.



BASE MAP IS AN ENLARGEMENT OF A PORTION OF FIGURE 2-1.

FIGURE 1

OBSERVATION WELL LOCATION MAP
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

SCALE: 1" = 1000'

NUS CORPORATION
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Twenty-five newly installed and existing monitoring wells were used as observation wells for this pumping test. Continuous water level recorders monitored water level fluctuations in 10 wells. The remaining 15 wells were measured using an M-scope and/or a chalked steel tape. Table 1 lists the observation wells monitored for this test. Figure 1 depicts the locations of the monitoring wells in relation to the Caldwell Trucking Company Site and the pumping well, Municipal Well No. 7.

3.0 Groundwater

As described in Volume I of this report, the geology of the site and surrounding area was characterized by glacial sediments that overlie a basalt bedrock. Information gathered during this investigation indicate that both the glacial sediments and the bedrock are used as sources of water in this area.

4.0 Groundwater Level Fluctuations

Groundwater levels were obtained in monitoring wells using two methods--manual measurements with a M-scope several times a week, and continuous water level recorders placed on selected wells. The purposes of obtaining continuous water level records were as follows:

- To identify the response of the shallow and deep groundwater systems to local pumping by individual or private wells in the project area.

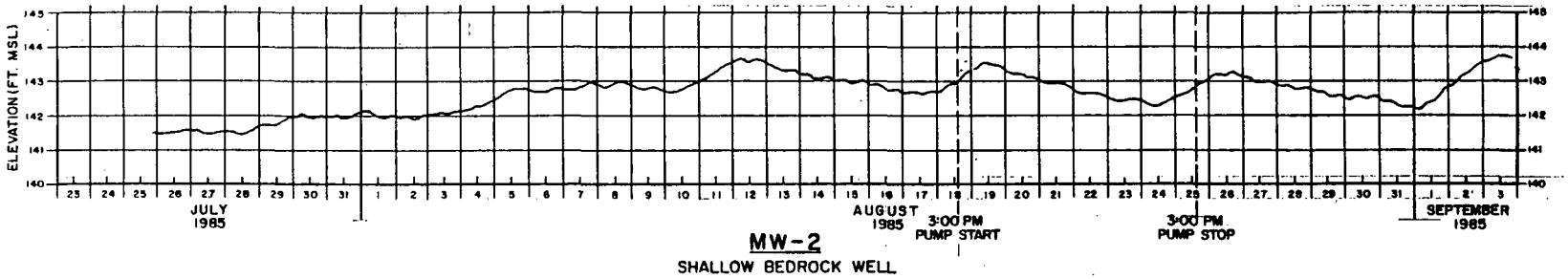
- To determine the impact of the local pumping on groundwater flow directions in the project area.

Figures 2 through 6 show records of water level elevations for wells that were measured with continuous recorders.

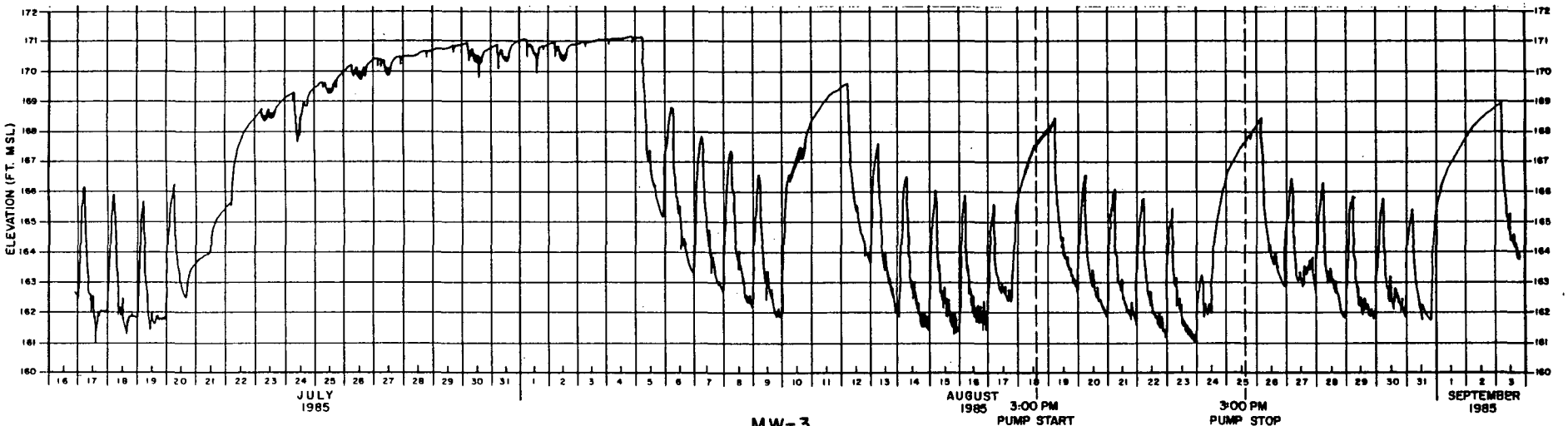
TABLE 1

OBSERVATION WELLS
CALDWELL TRUCKING COMPANY SITE

Well No.	Distance from Pumping Well (ft)	Method of Water Level Measurement
MW-1	4,390	M-Scope
MW-1A	4,400	M-Scope
MW-2	3,280	Continuous Recorder
MW-2A	3,280	M-Scope
MW-3	3,500	Continuous Recorder
MW-3A	3,450	M-Scope
MW-4	3,175	Continuous Recorder
MW-4A	3,180	Continuous Recorder
MW-5	970	Continuous Recorder
MW-5A	970	Continuous Recorder
MW-6	365	Continuous Recorder
MW-6A	370	Continuous Recorder
MW-8	2,520	Continuous Recorder
MW-9	455	Continuous Recorder
MW-10	430	Continuous Recorder
"Wishing" Well	145	M-Scope
CTMW-1	3,470	M-Scope
CTMW-3	3,320	M-Scope
CTBR	3,440	M-Scope
P-1	7,210	M-Scope
P-1A	7,200	M-Scope
P-2	6,620	M-Scope
P-2A	6,610	M-Scope
"Marvel" Well	2,785	M-Scope



MW-2
SHALLOW BEDROCK WELL



MW-3
DEEP BEDROCK WELL

Note: Blank spaces within continuous record indicate unavailable data for that time period.

FIGURE 2

CONTINUOUS RECORD OF WATER LEVEL ELEVATIONS
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

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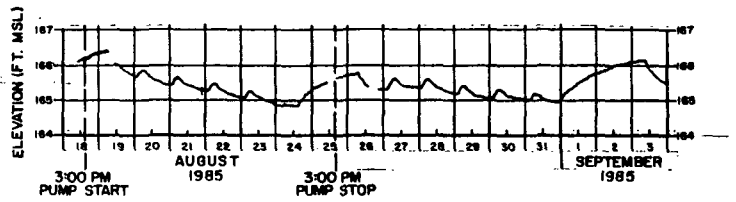
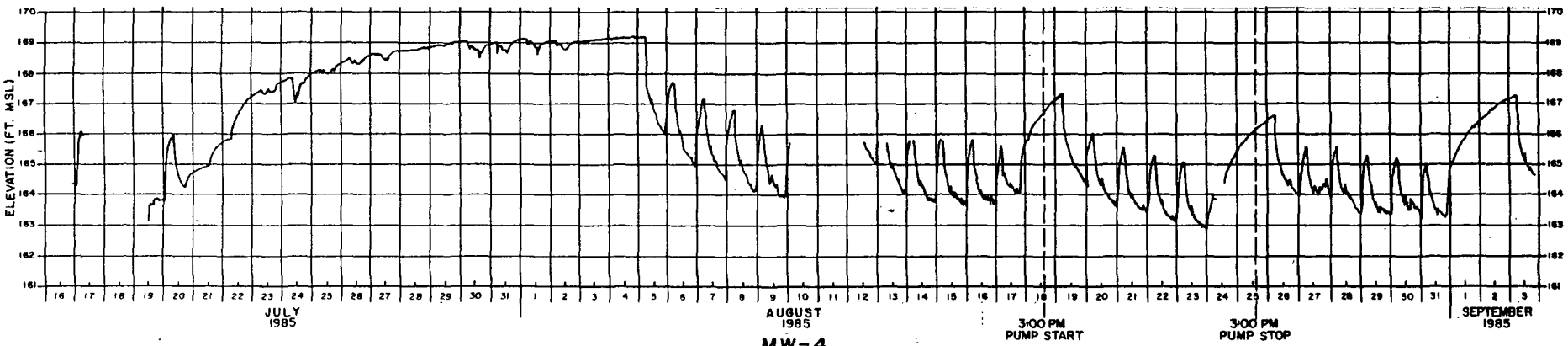


MW-4A

GLACIAL SEDIMENT WELL



MW-4

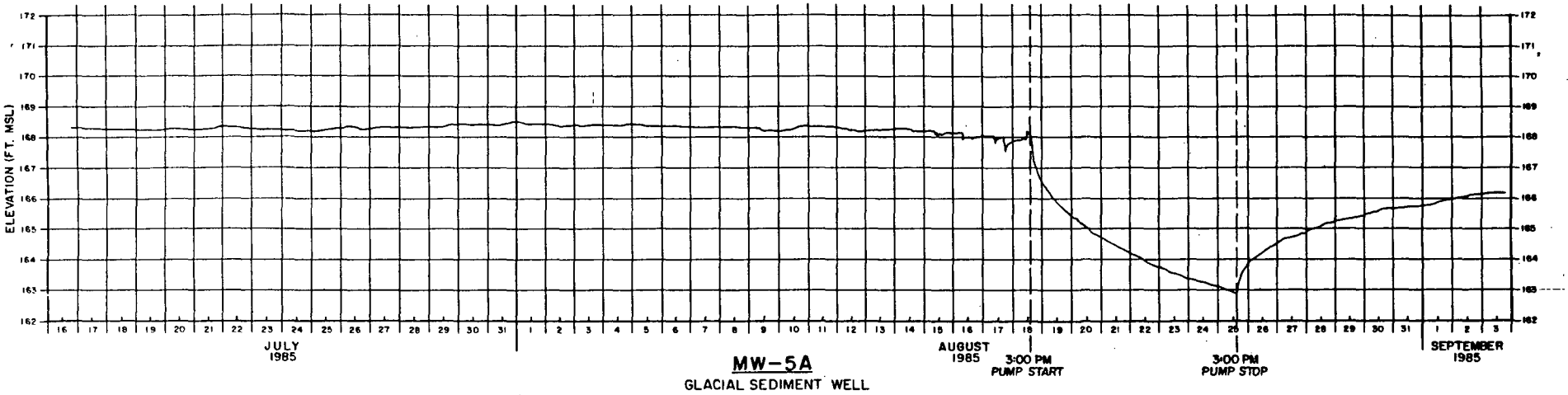
DEEP BEDROCK WELL

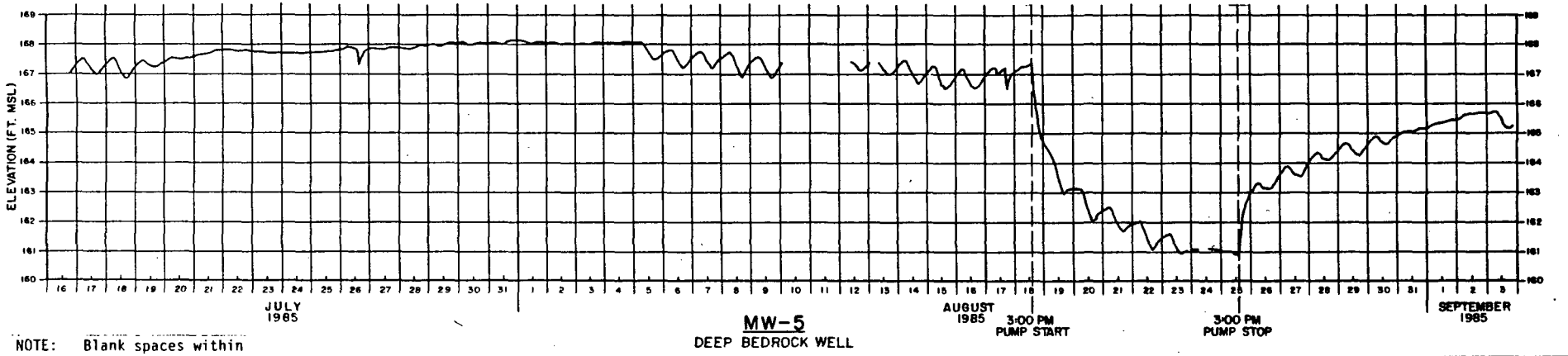
NOTE: Blank spaces within continuous record indicate unavailable data for that time period.

FIGURE 3

CONTINUOUS RECORD OF WATER LEVEL ELEVATIONS
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company



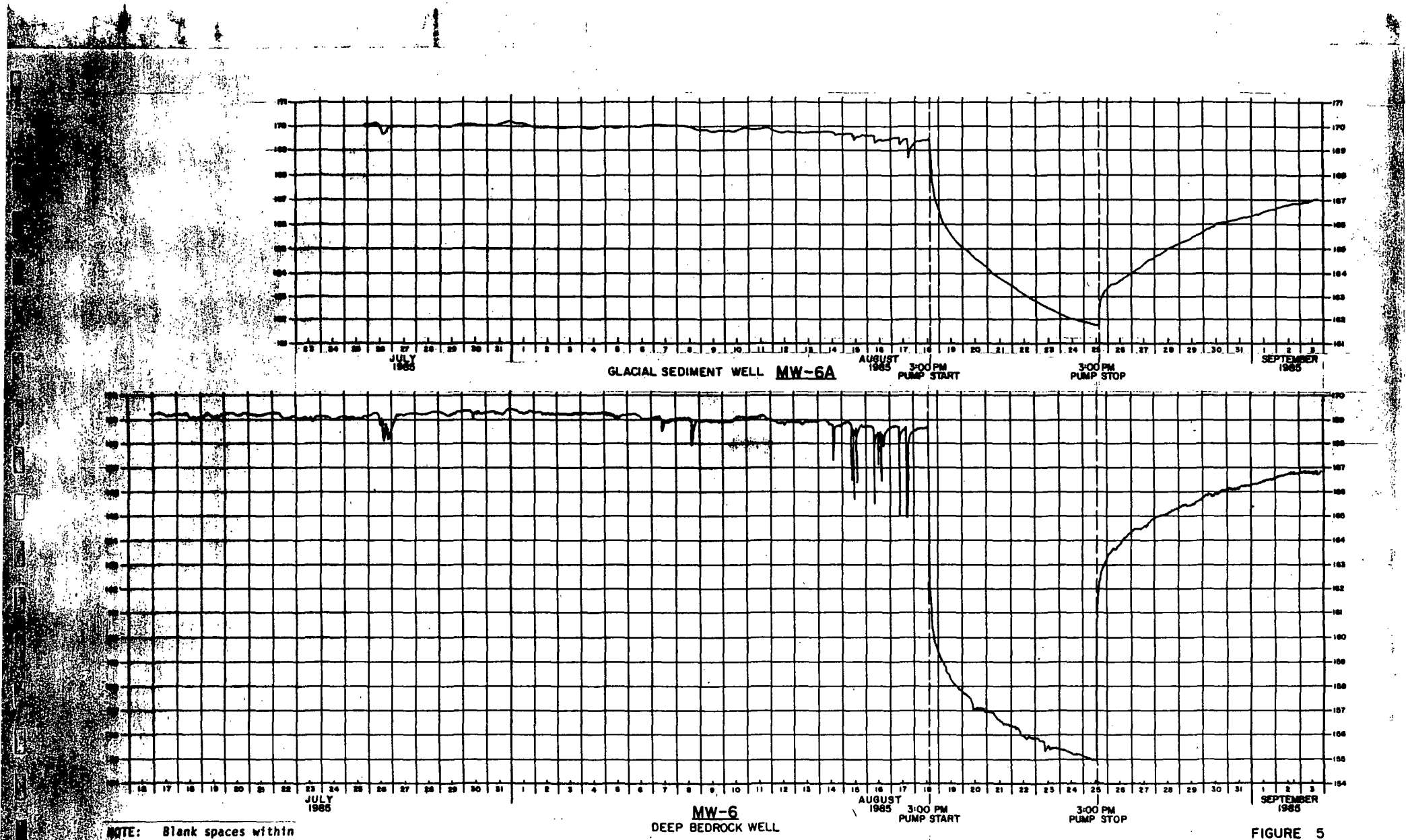


NOTE: Blank spaces within continuous record indicate unavailable data for that time period.

FIGURE 4

CONTINUOUS RECORD OF WATER LEVEL ELEVATIONS
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

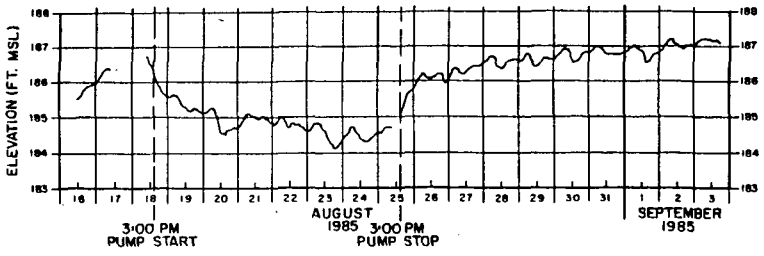


NOTE: Blank spaces within continuous record indicate unavailable data for that time period.

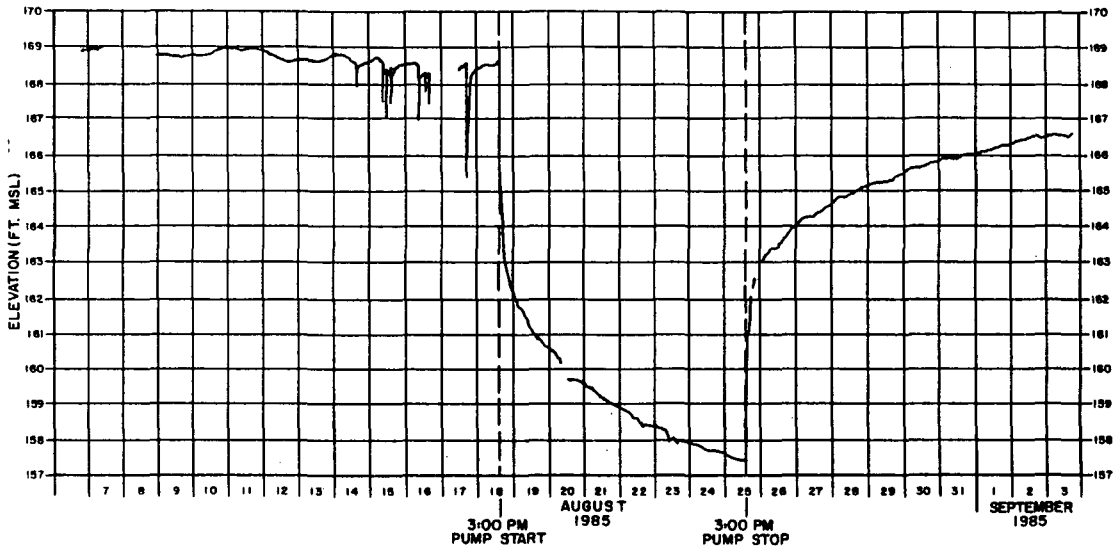
FIGURE 5

CONTINUOUS RECORD OF WATER LEVEL ELEVATIONS
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company



MW-10
DEEP BEDROCK WELL



MW-9
DEEP BEDROCK WELL

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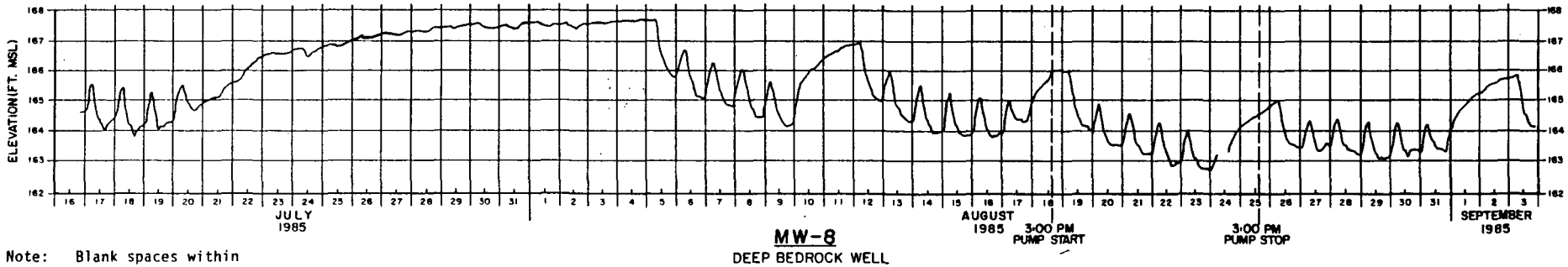

MW-8
DEEP BEDROCK WELL

Note: Blank spaces within continuous record indicate unavailable data for that time period.

FIGURE 6

CONTINUOUS RECORD OF WATER LEVEL ELEVATIONS
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

Figures 7 through 13 are hydrographs of water level elevations in wells measured with an M-scope. As shown on these graphs, measurements taken prior to August 18, 1985 were taken several times a week. Daily trends cannot be identified using this information.

Precipitation at the site was measured during this investigation using a rain gauge set near the site operations trailer. The rain gauge was checked daily and rainfall amounts were recorded when observed. Water levels in monitoring wells were not observed to be affected by rainfall. It should be noted that the investigation was carried out in the summer and general weather records indicate the project area was experiencing an abnormally dry summer season. Site-specific precipitation measurements can be found in Appendix B.

Barometric pressure readings were recorded from instrumentation at the Essex County Airport, adjacent to the project site. No correlation between barometric pressure and water level fluctuation in the monitoring wells was observed. Barometric pressure readings can be found in Appendix B.

Analysis of continuous water level records reveal that the water levels in the project area were being affected by pumping of private and/or industrial wells in the vicinity of the site. Using a survey of the operating pumps in the project area and correlating daily use of these pumps with water level fluctuations in the monitoring wells, two industrial wells were found to be the major contributors to pumping effects observed in the monitoring wells. These pumping wells were owned by General Hose Products, Inc. (General Hose), and the Unimatic Manufacturing Corporation (Unimatic). Figure 1 shows the location of these wells.

Existing well information show that both of these industrial wells are completed into bedrock. The General Hose well was completed into the shallow bedrock (approximately 60 feet into rock) while the Unimatic well was completed into deep bedrock (approximately 180 feet into rock).

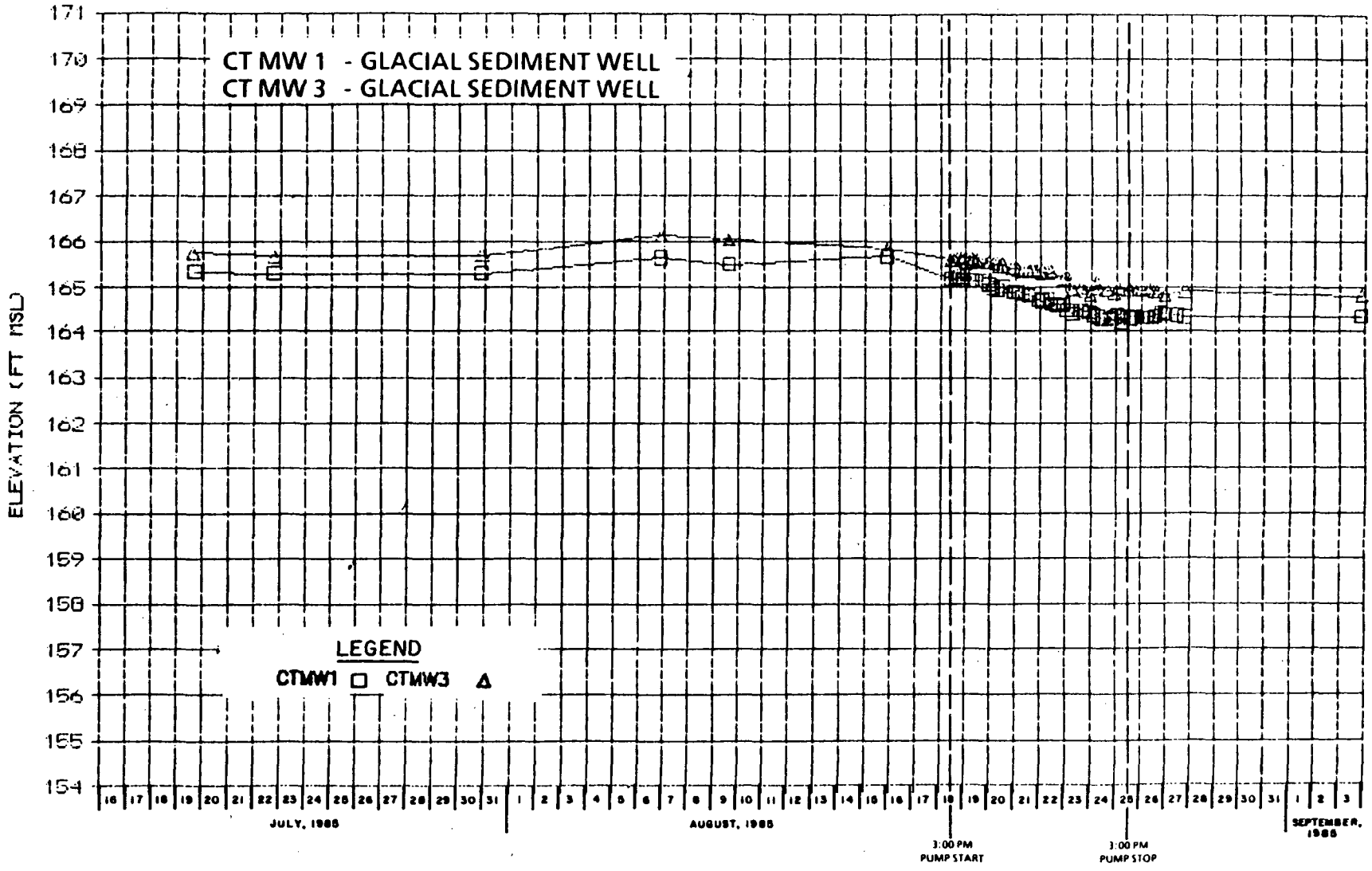

FIGURE 7

GRAPH OF WATER LEVEL ELEVATIONS FOR WELLS
CTMW I AND CTMW 3
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

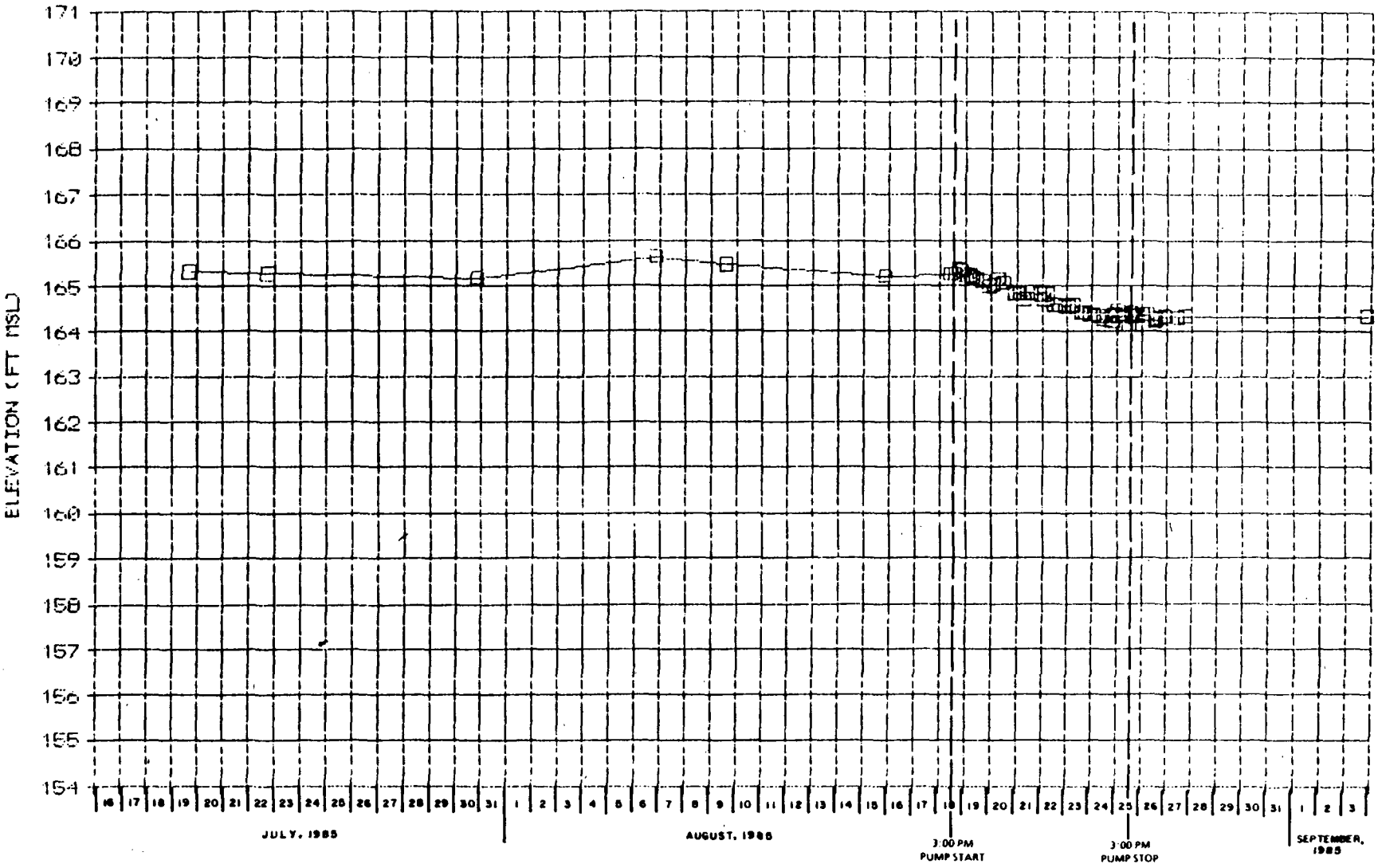

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FIGURE 8

GRAPH OF WATER LEVEL ELEVATIONS FOR CTBR WELL
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

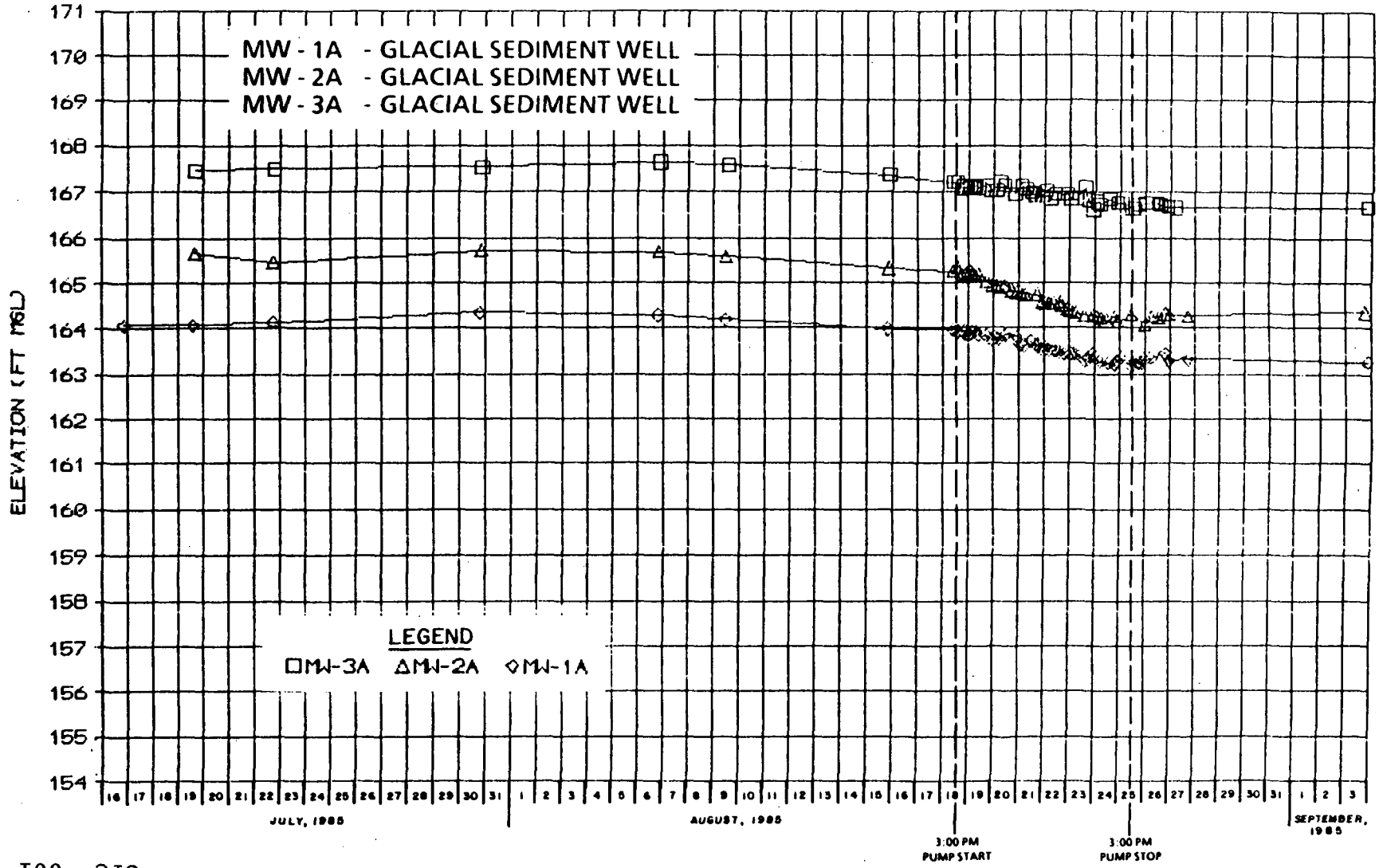

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FIGURE 9

GRAPH OF WATER LEVEL ELEVATIONS FOR WELLS
MW-1A, MW-2A AND MW-3A
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

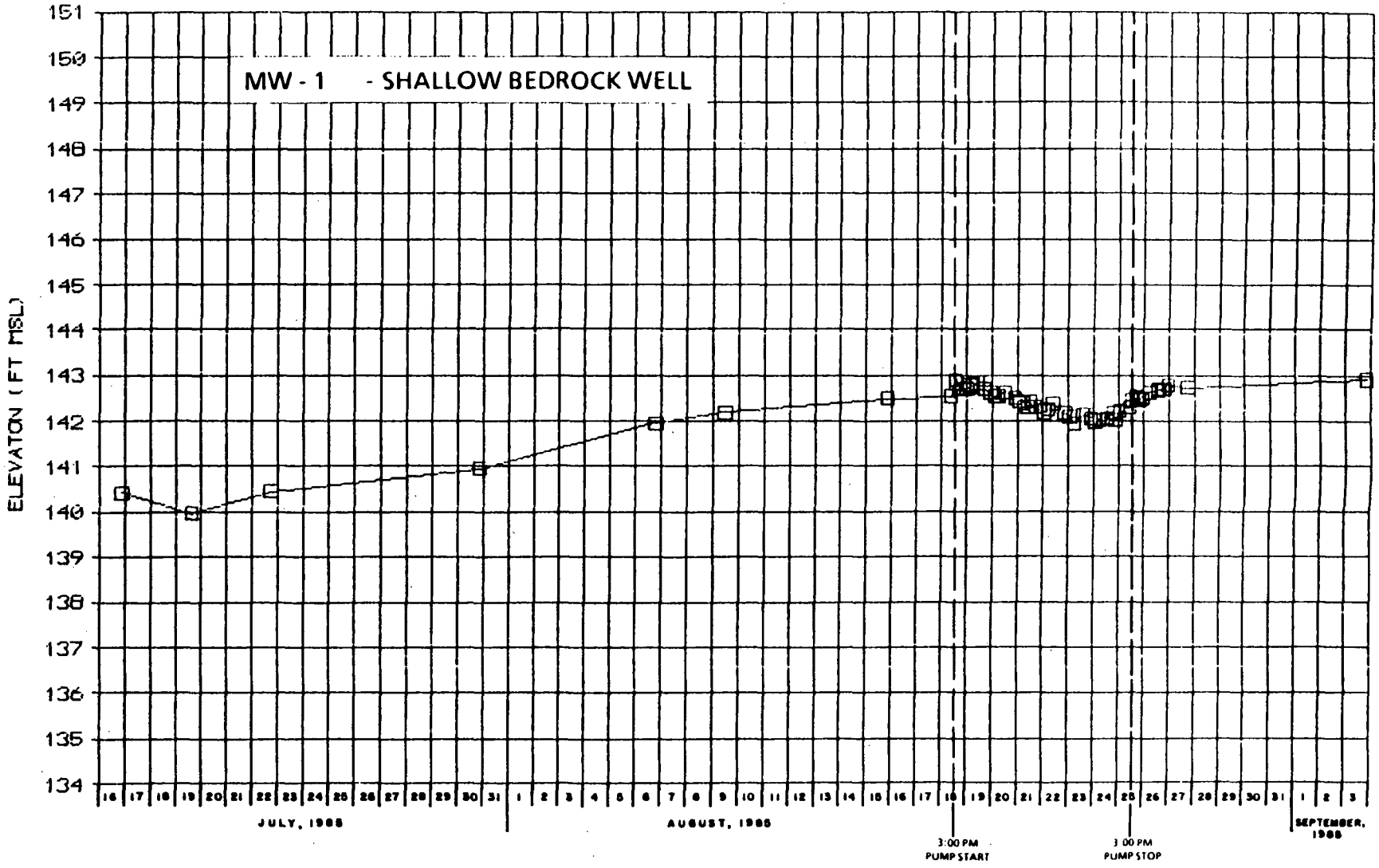

FIGURE 10

GRAPH OF WATER LEVEL ELEVATIONS FOR WELL MW-1
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

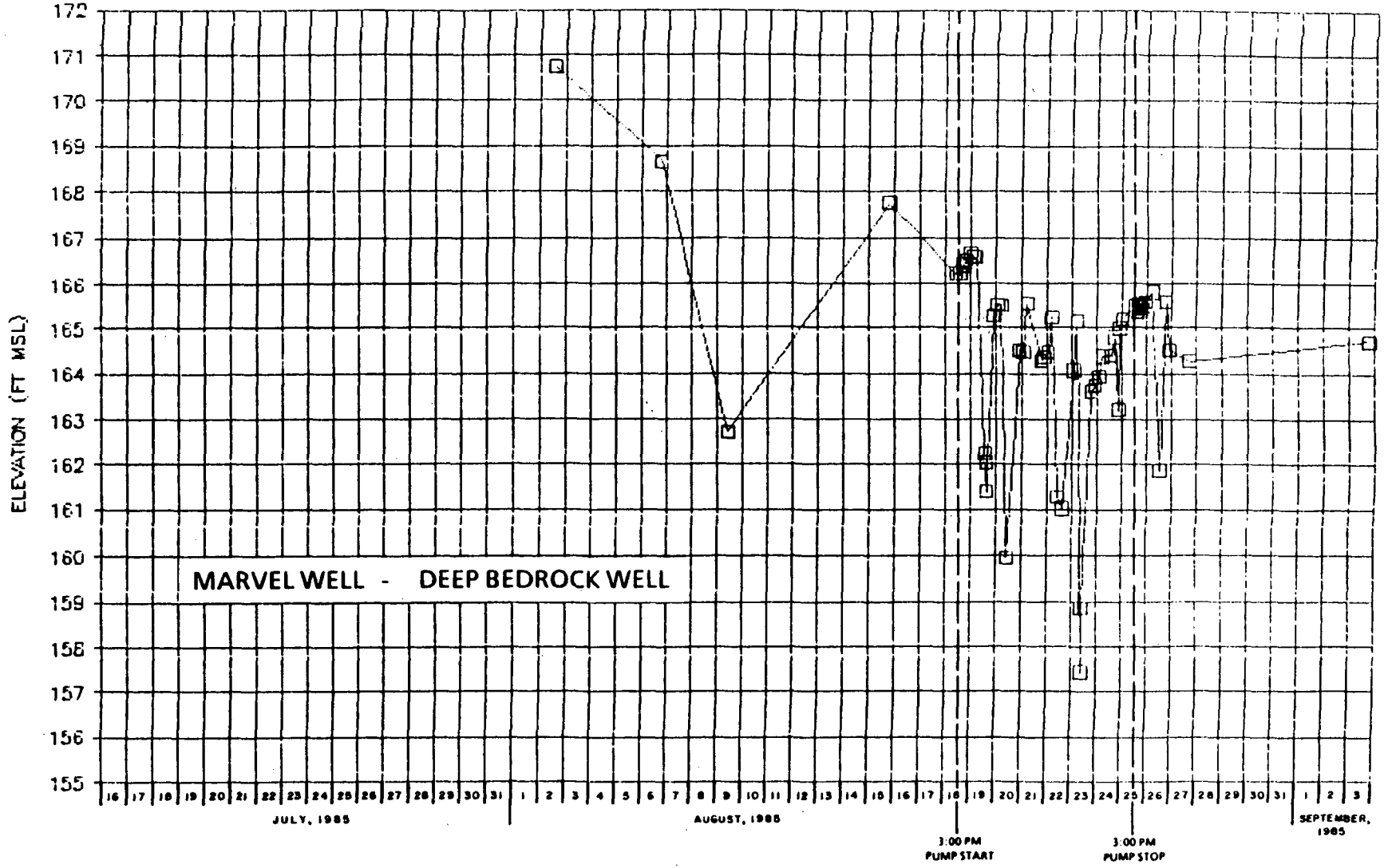

FIGURE 11

GRAPH OF WATER LEVEL ELEVATIONS FOR MARVEL WELL
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

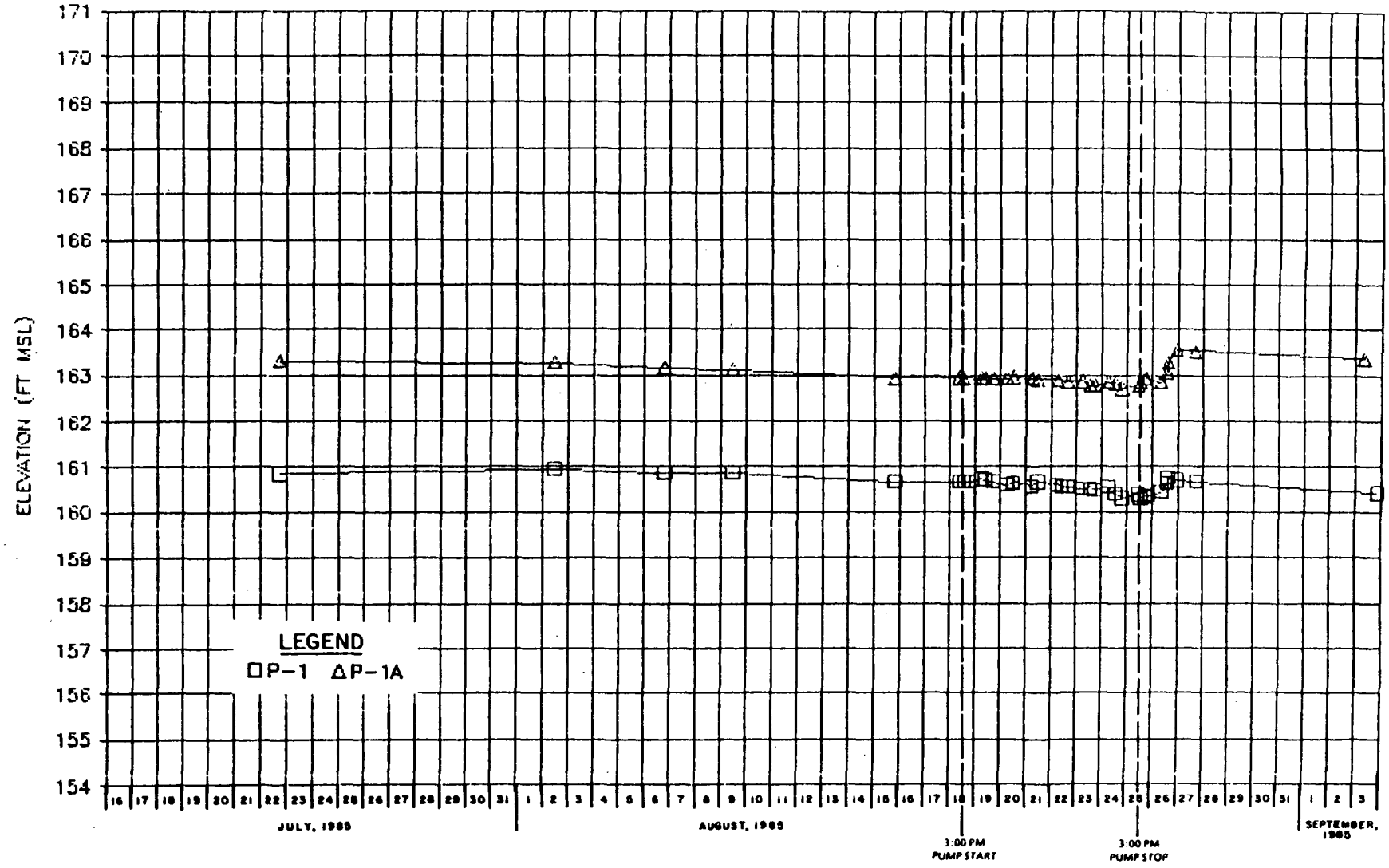

FIGURE 12

GRAPH OF WATER LEVEL ELEVATIONS FOR WELLS P-1 & P-1A
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

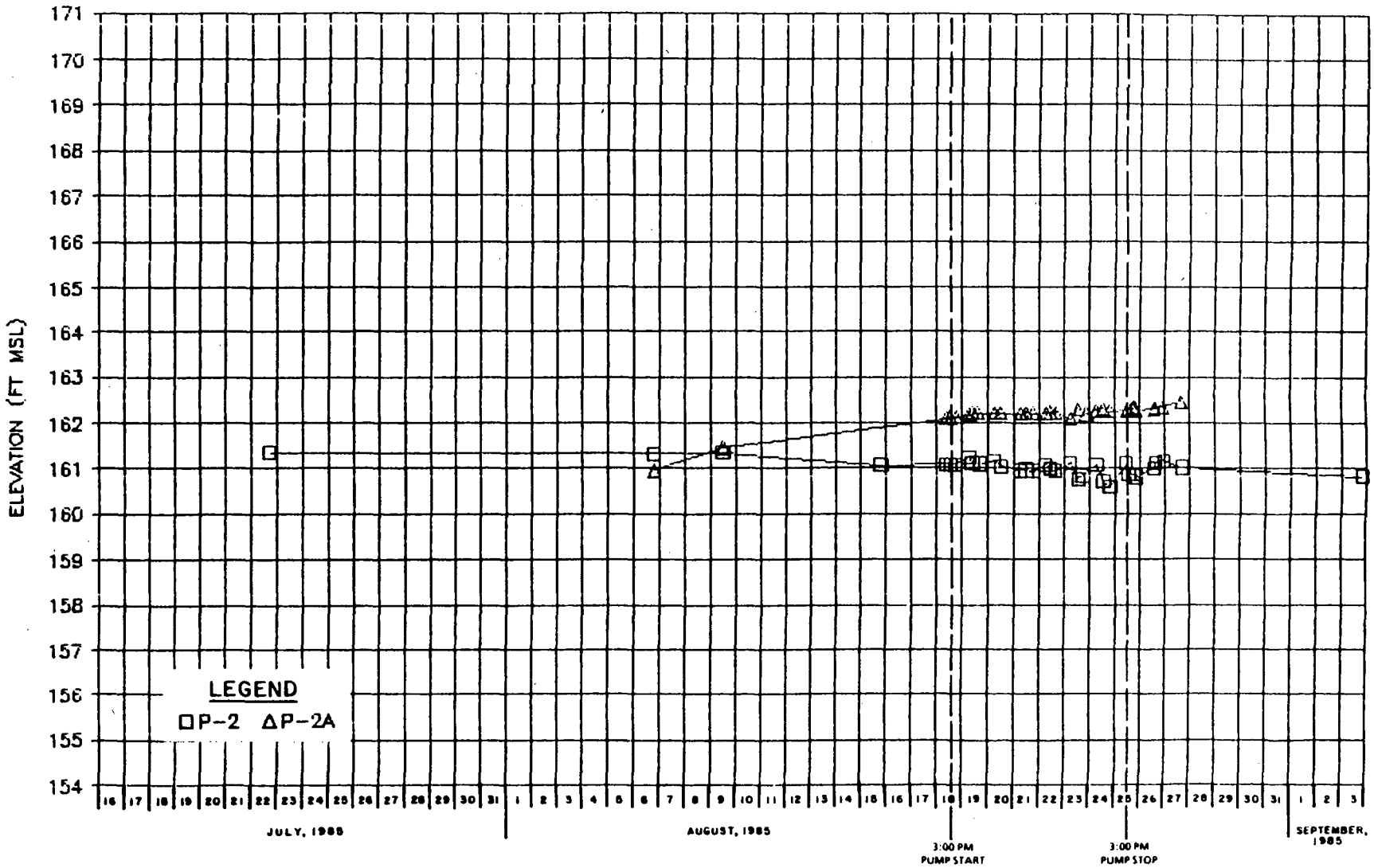

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FIGURE 13

GRAPH OF WATER LEVEL ELEVATIONS FOR WELLS P-2 & P-2A
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

Pumping by Unimatic caused the major drawdown effect observed in bedrock monitoring wells MW-2, 3, 4, 5, and 8. General Hose pumping effects could only be observed when the drawdown from Unimatic pumping had stabilized or when Unimatic was not pumping. This could clearly be seen in wells MW-3 and 4, from July 22 through August 5, 1985 when the Unimatic facility was not operating. It should be noted that detailed information including pumping rates and drawdown at these pumping wells were not available from General Hose or Unimatic during this investigation.

A daily drawdown effect caused by Unimatic pumping can also be seen in glacial sediment well MW-4A, as shown on Figure 3. A drawdown effect in this shallow well, caused by pumping in the deep bedrock well, indicates that the two groundwater systems are hydraulically connected in this area. This type of drawdown effect was also observed during the large-scale pumping test in shallow glacial sediment wells located near the pumping well PW-7.

Another private well owned by the Marvel Manufacturing Company (Marvel) was observed to be pumping periodically during this investigation. This can be seen on a hydrograph of the Marvel well (Figure 11). This well was pumped for short intervals when in use. Effects of pumping this well were not observed in other nearby monitoring wells.

5.0 Well No. 7 Aquifer Test Analyses

Figure 14, a hydrograph for the pumping Well No. 7, (PW-7), shows that drawdowns were measured in this well prior to the start of the pumping test on August 18, 1985. These drawdowns were due to the pumping of Well No. 7 for short periods of time, to ensure the pump and discharge system was working correctly. It should be noted that drawdown from this short duration pumping can also be seen in monitoring wells MW-5, 5A, 6, 6A, and 9 (Figures 4, 5, and 6).

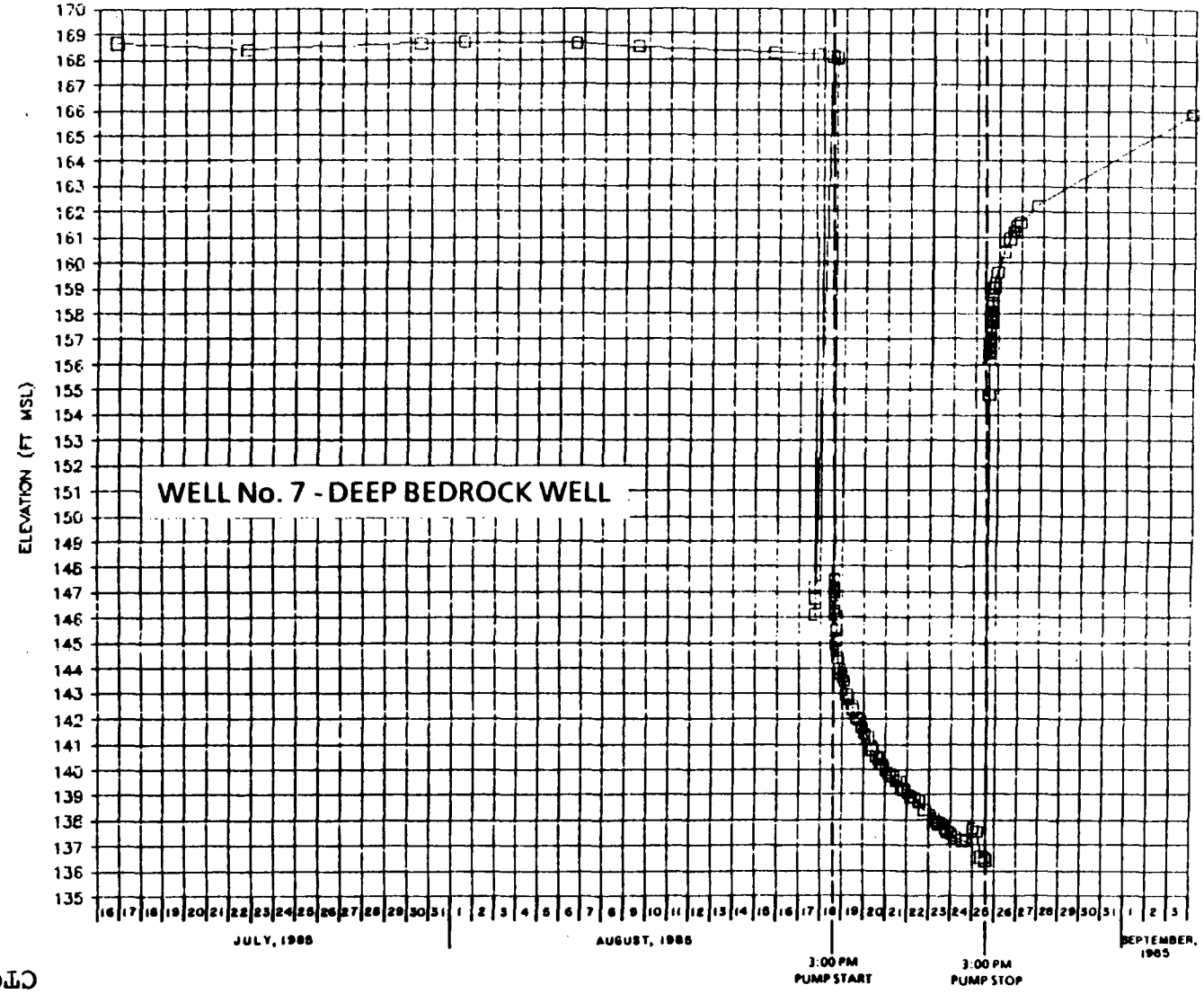

FIGURE 14

GRAPH OF WATER LEVEL ELEVATIONS FOR WELL No. 7
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

An unused private well adjacent to the pumping well was also used as an observation well during this test. Figure 15 shows water level elevations for this well measured during the pumping test.

Analysis of water level elevation records show that drawdown due to pumping of Well No. 7 occurred in several bedrock and glacial sediment observation wells. Table 2 lists the drawdown observed at the end of the test in these wells.

Pumping effects caused by Unimatic made drawdown analysis near the Caldwell Trucking Company Site difficult. Drawdown was interpreted in bedrock well MW-4 adjacent to an existing onsite lagoon, but this drawdown was identified by changes in weekly trends associated with Unimatic pumping before, during, and after the pumping test. No drawdown, from pumping Well No. 7 was identified in bedrock well MW-3.

Figures 7 and 8 show hydrograph plots of additional monitoring wells CTMW-1 and 3, MW-1A, 2A, and 3A that were measured with an M-scope. These wells are completed into the shallow glacial sediments, similar to well MW-4A. As stated previously, the continuous record for MW-4A (Figure 3) was interpreted as showing a daily drawdown effect associated with Unimatic pumping. The continuous record for MW-4A does not show a distinct drawdown associated with pumping of Well No. 7. Because these wells are similar to MW-4A in geologic zone monitored, are a greater distance from Well No. 7, and are closer to the Unimatic well, the drawdown trends seen over the week of the pumping test in these wells are similar to MW-4A and, therefore, most likely caused by pumping of the Unimatic well.

Shallow bedrock wells CTBR and MW-1, shown in Figures 7 and 9, are similar to shallow bedrock well MW-2 (Figure 2). The continuous record for MW-2 again was interpreted as showing only the effect of Unimatic pumping. Because these wells are monitoring the same geologic zone as MW-2 and are farther away from Well No. 7, the drawdown trends observed in shallow bedrock wells CTBR and MW-1 are most likely from Unimatic pumping.

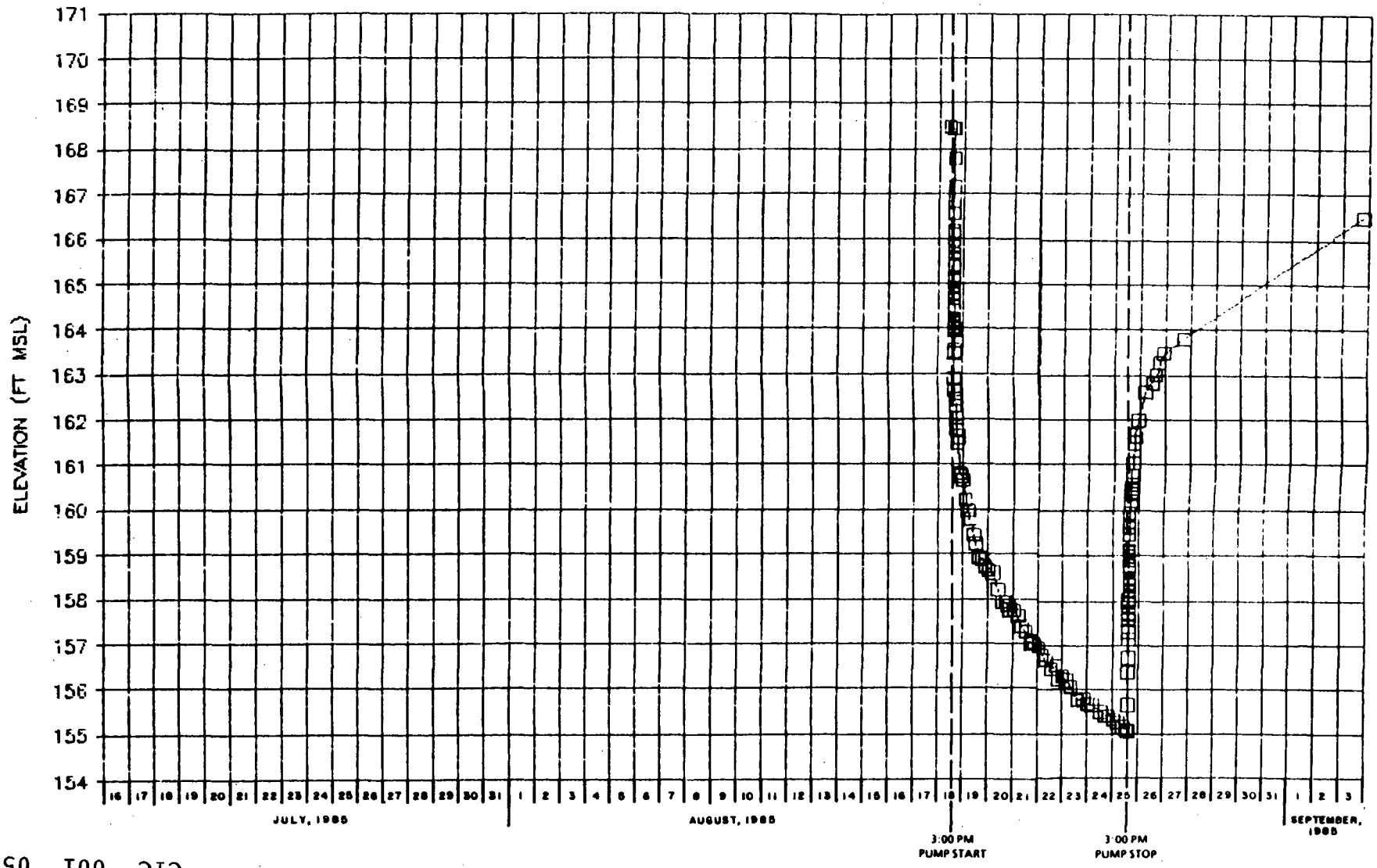

FIGURE 15

GRAPH OF WATER LEVEL ELEVATIONS FOR "WISHING" WELL
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

TABLE 2

OBSERVATION WELL DRAWDOWN
CALDWELL TRUCKING COMPANY SITE

Well No.	Geologic Formation	Distance from Pumping Well (ft)	Drawdown at the End of Pumping (ft)
"Wishing" Well	Bedrock*	145	13.37
MW-10	Bedrock	430	1.90
MW-9	Bedrock	455	11.05
MW-6	Bedrock	365	13.75
MW-6A	Glacial sediment	370	7.70
MW-5	Bedrock	970	6.50
MW-5A	Glacial sediment	970	5.20
MW-8	Bedrock	2,520	0.70
MW-4	Bedrock	3,175	0.50
MW-3	Bedrock	3,500	0.0
PW-7**	Bedrock	NA	31.63

* Measured depth indicates completion into bedrock. No detailed well information available.

** Pumping Well

The location of the deep bedrock Marvel well, between MW-4 and 8, suggests that this well should also show drawdown due to pumping of Well No. 7. However, as depicted in Figure 11, daily use of the Marvel well itself made any interpretation during the pumping test impossible.

Figures 12 and 13 are hydrographs of the four small-diameter piezometer wells installed into the unconsolidated sediments adjacent to the Passaic River. Analysis of these figures reveals that drawdown and recovery trends could be interpreted in wells P-1 and P-1A. Because of the large distances from the Unimatic well and pumping Well No. 7 and the close proximity of these wells to the Passaic River, the apparent drawdown and recovery trends are mostly likely from river water level fluctuations. A precipitation event that was recorded after pump shutdown (see rainfall records in Appendix B) increased the river water level and correlated with the water level elevation rise in wells P-1 and P-1A on August 26, 1985.

A semi-logarithmic plot of drawdown versus distance for bedrock observation wells is shown in Figure 16. This figure again demonstrates no drawdown for MW-3 and small drawdowns for MW-4, 8, and 10. Well MW-10, though, was not used in the interpretations because of its anomalies from other deep bedrock wells, as discussed earlier. The Jacob straight line method was used to calculate the coefficient of storage and transmissivity from this plot as listed on this figure.

Figures 17 through 21 are semi-logarithmic plots of both drawdown and recovery versus time in the bedrock pumping well and bedrock observation wells where drawdown was observed. Again, the Jacob straight line method was used to compute the coefficients of transmissivity in the pumping well and coefficients of storage and transmissivity in the observation wells listed on the figures. Table 3 is a summary of the storage and transmissivity coefficients calculated for these wells.

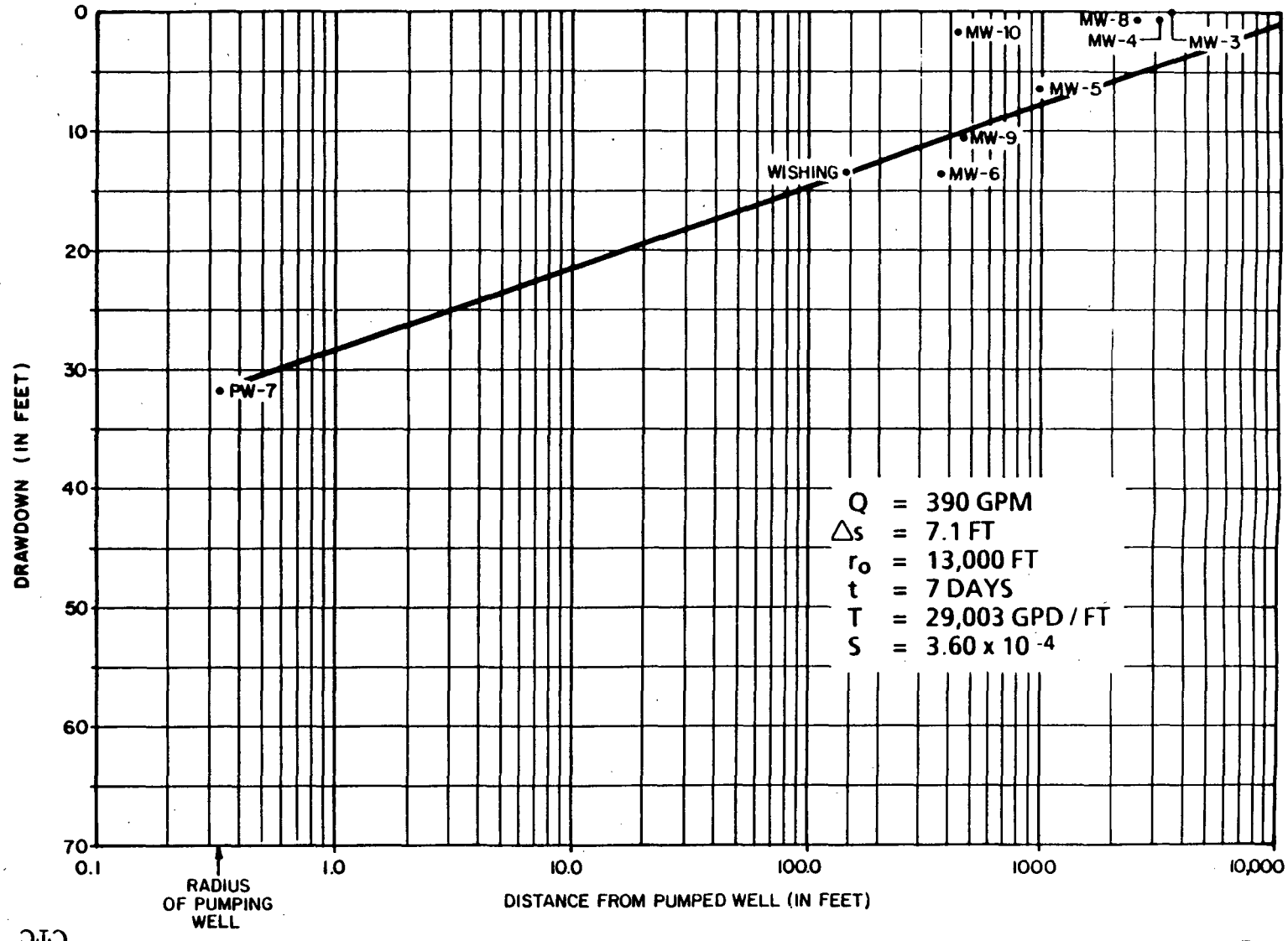

FIGURE 16

SEMI-LOGARITHMIC PLOT OF DRAWDOWN AND DISTANCE
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

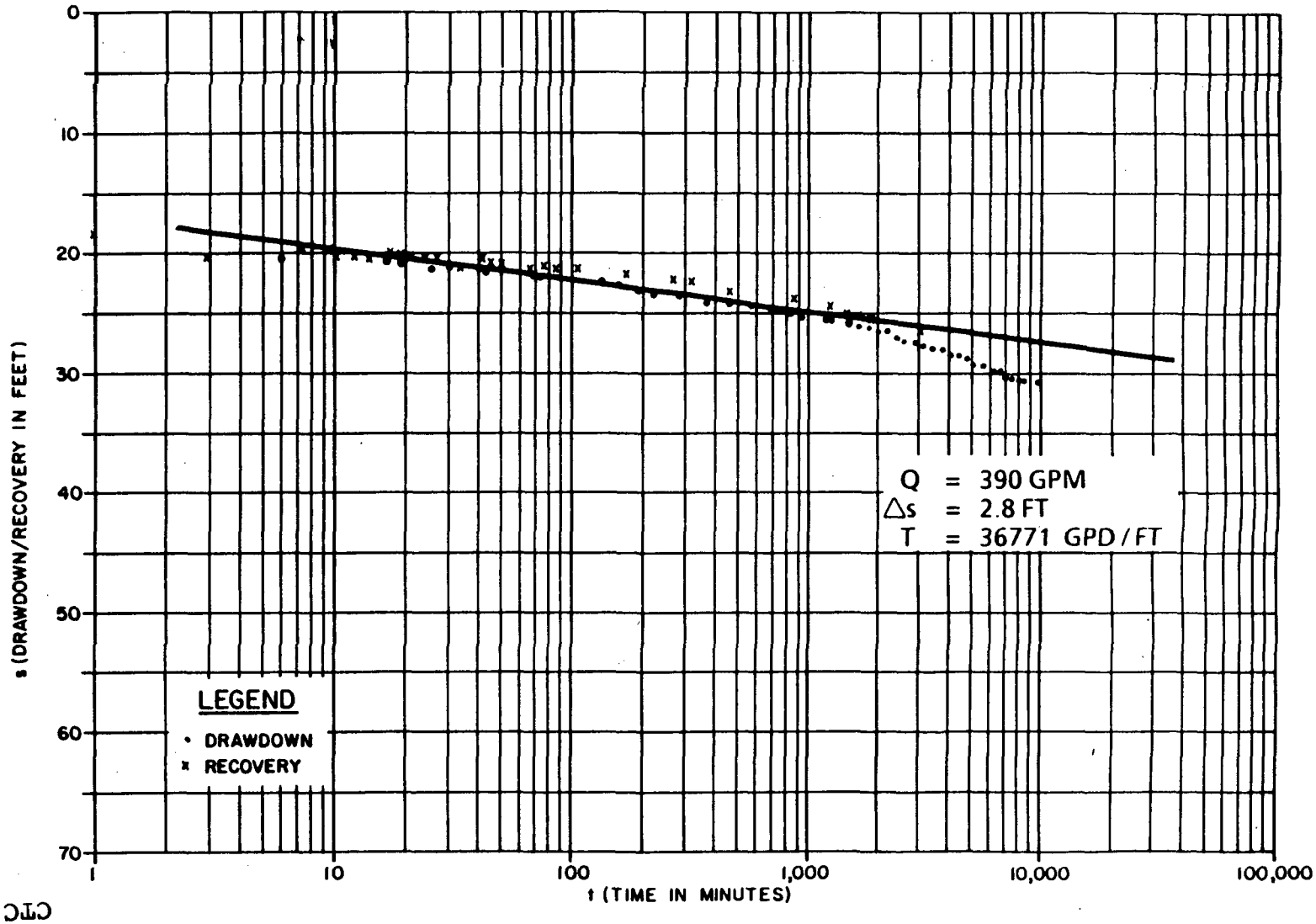

FIGURE 17

SEMI-LOGARITHMIC PLOT OF DRAWDOWN AND RECOVERY
IN PUMPING WELL Nº 7
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

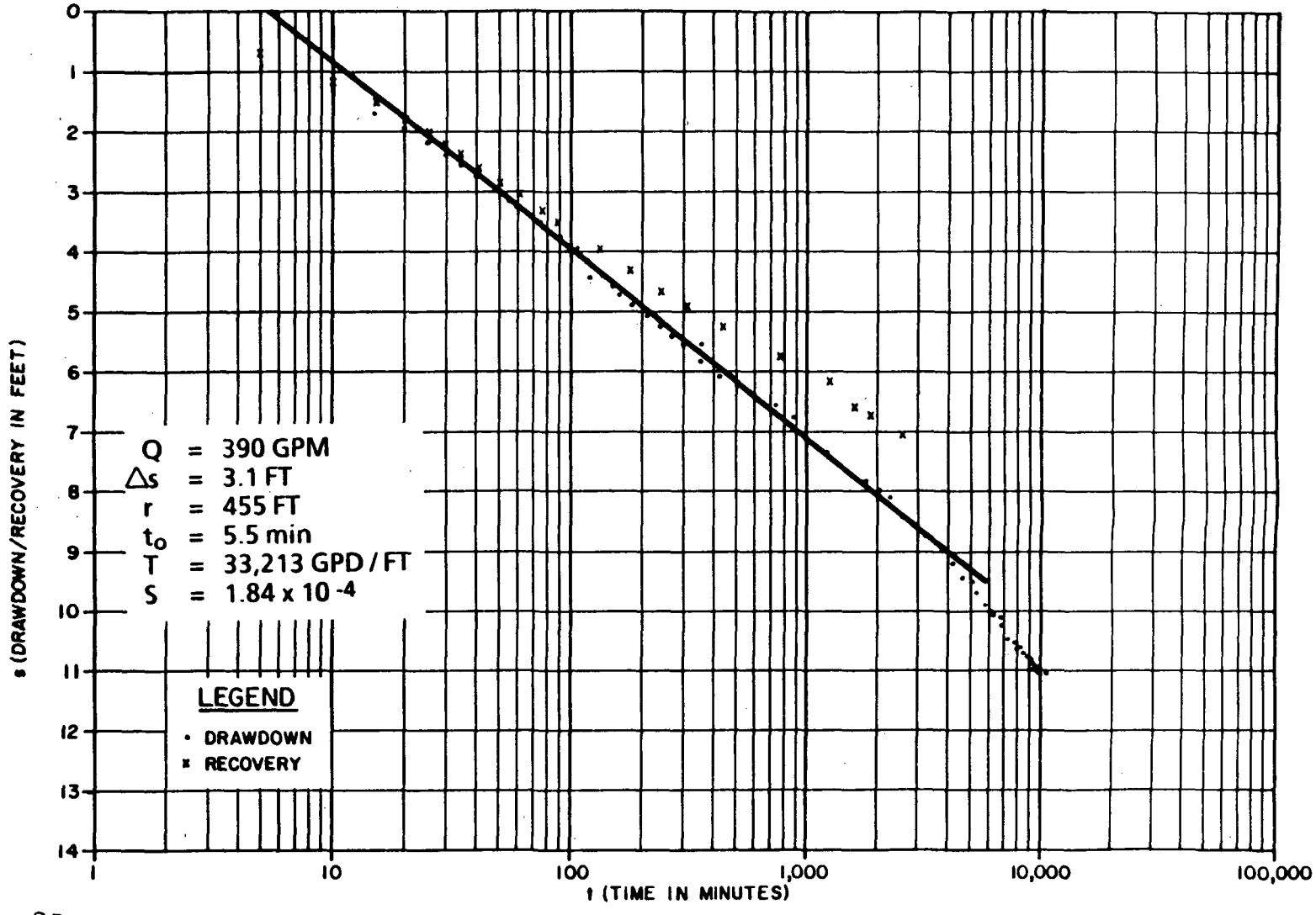

FIGURE 18

SEMI-LOGARITHMIC PLOT OF DRAWDOWN AND RECOVERY
IN OBSERVATION WELL MW-9
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

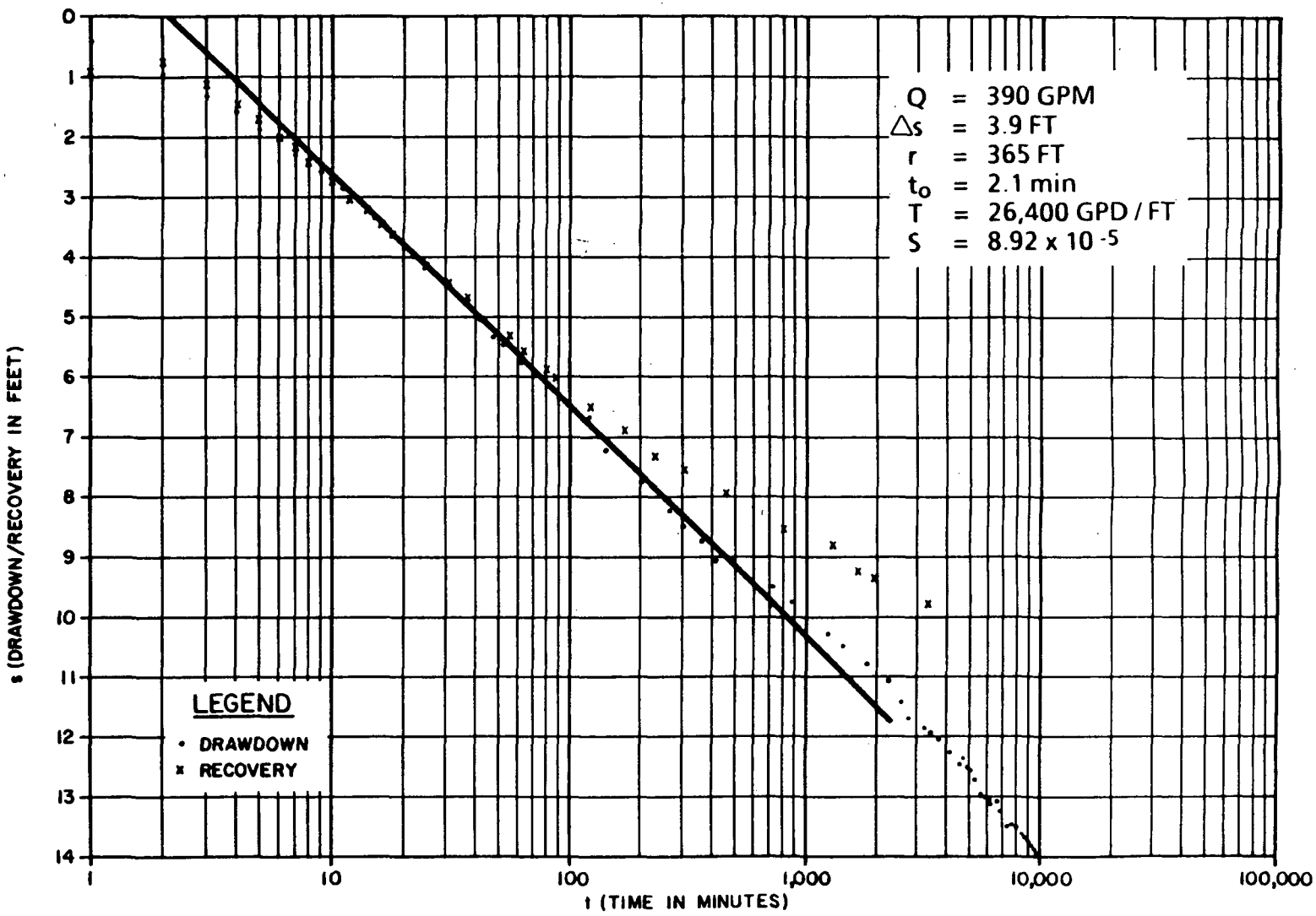

FIGURE 19

SEMI-LOGARITHMIC PLOT OF DRAWDOWN AND RECOVERY
IN OBSERVATION WELL MW-6
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

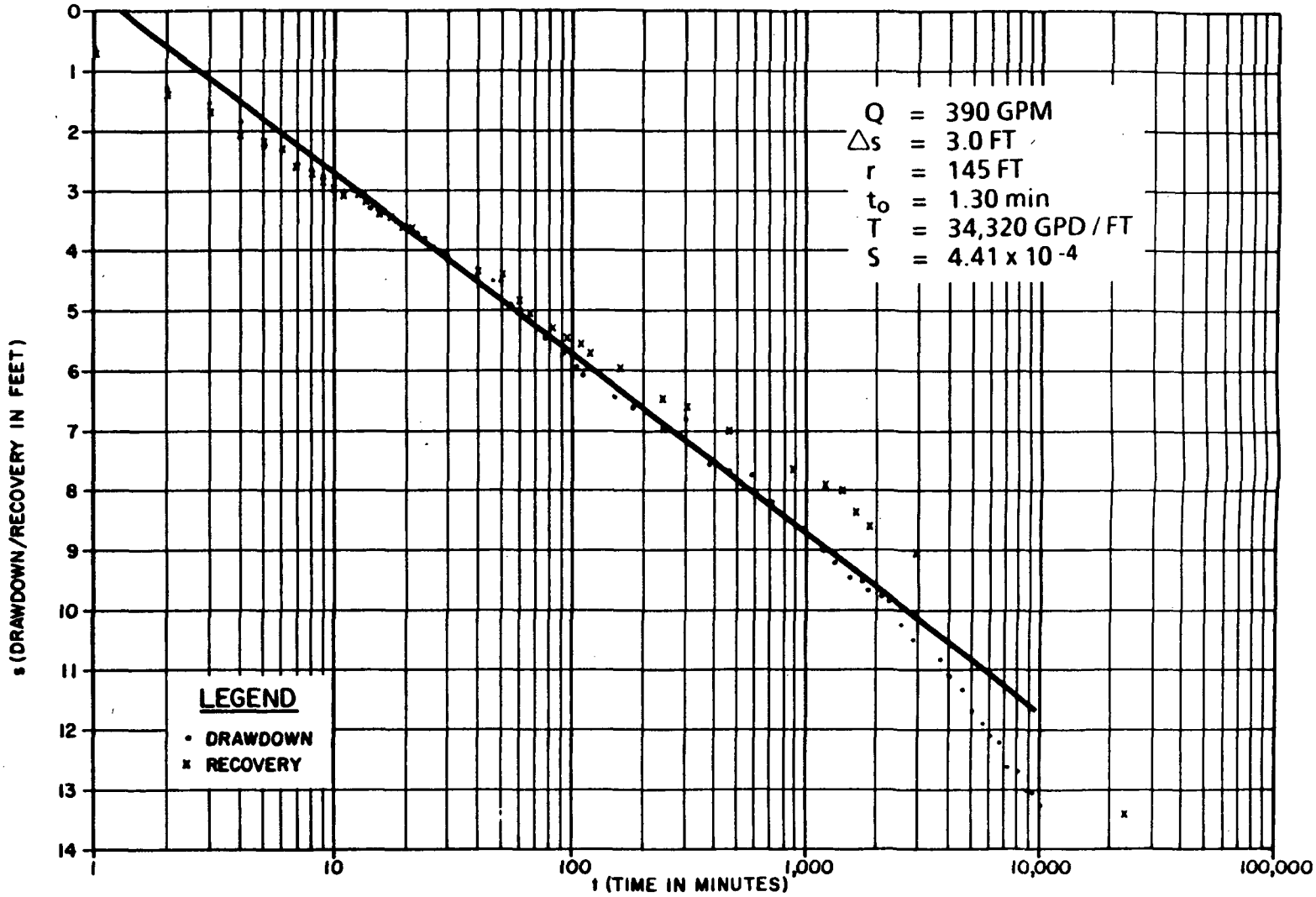

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FIGURE 20

SEMI-LOGARITHMIC PLOT OF DRAWDOWN AND RECOVERY
IN THE "WISHING" WELL
CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

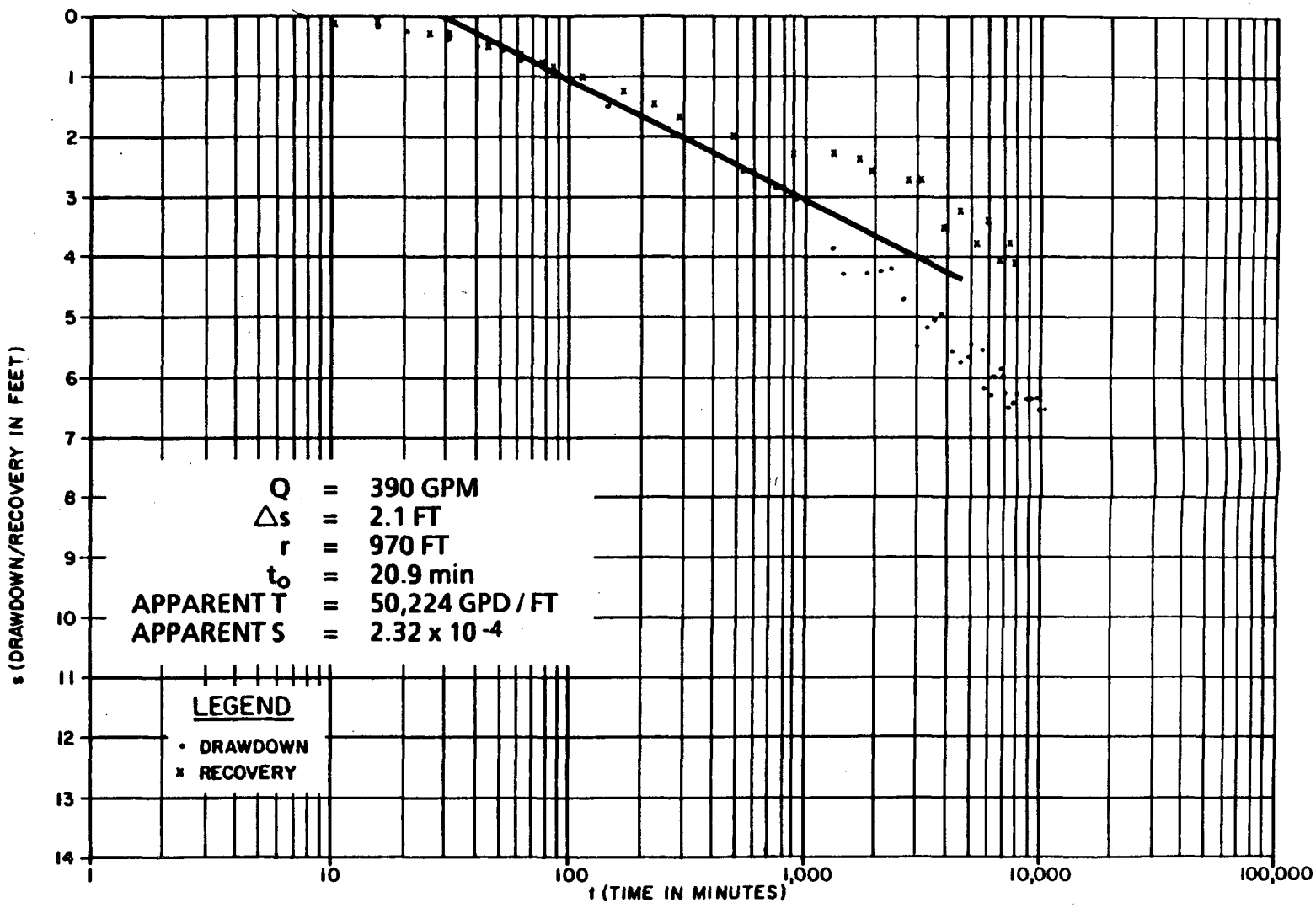

FIGURE 21

SEMI-LOGARITHMIC PLOT OF DRAWDOWN AND RECOVERY IN OBSERVATION WELL MW-5 CALDWELL TRUCKING CO. SITE, FAIRFIELD TWP., NJ

NUS CORPORATION
A Halliburton Company

TABLE 3

BEDROCK AQUIFER
HYDRAULIC PARAMETERS
CALDWELL TRUCKING COMPANY SITE

Well No.	Hydrogeologic Unit	S Storage	T Transmissivity Pumping Test (gpd/ft)
PW-7	Deep Bedrock	--	36,771
MW-9	Deep Bedrock	1.84×10^{-4}	33,213
MW-6	Deep Bedrock	8.92×10^{-5}	26,400
MW-5	Deep Bedrock	2.32×10^{-4}	50,224
"Wishing" Well	*Deep Bedrock	4.41×10^{-4}	34,320

*Deep bedrock hydrogeologic unit interpreted.
No detailed well information available.

Analysis of the semi-logarithmic plots for wells PW-7 (Well No. 7), MW-5 and 9, and the "Wishing" well (Figure 17, 18, 20, and 21) show two distinct slopes of the plotted measurements, with the second slope steeper than the first. This steeper slope indicates a discharge boundary effect that may be caused by the pumping of another well, such as the Unimatic well, a change (discontinuance) of the water-bearing fracture zones in the bedrock, or a lithologic change in the bedrock. One or all three of these will affect the observed drawdown in the observation wells.

Figure 21 shows the plot for bedrock well MW-5. Analysis of this plot indicates drawdown measurements increase and decrease erratically after approximately 15 hours (900 minutes) of pumping PW-7. This drawdown variance was the effect of Unimatic pumping during the test.

A comparison of the transmissivity (T) values calculated for bedrock observation wells (Table 3) show that the T value for MW-5 was significantly higher than the values in other wells. As stated previously, the glacial and bedrock aquifer systems are hydraulically connected. Transmissivity values generally increase with distance from the pumping well under leaky conditions. The distance of MW-5 from the pumping well was the largest of the wells used for analysis (MW-6 and 9, and the "Wishing" well). Therefore, leakage from the glacial sediments into the bedrock reduced the drawdown observed in MW-5 and correspondingly increased the T value calculated for this well.